Are First Year Medical Students Distracted by On-Screen Exams in Relation to On-Paper Exams

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ABSTRACT

Assessment over the electronic media has been questioned for its validity and sensitivity, especially for the purpose of evaluating a student at the university level, though not for competitive exams. On-screen visibility, readability and interpretation during an exam are under cynicism as compared to paper. We have undertaken the evaluation of the effectiveness of on-screen examinations in comparison to pen and paper exams. Both on-screen and on-paper exams were conducted during November 2013, enrolling 180 students. These were divided into 61 male students taking an on-paper exam, immediately followed by the on-screen exam with the same set of questions. Similarly a batch of 57 girl students took an initial exam on-paper and then the same questions were displayed on the screen. 31 students were given on-screen exam only, and yet another 31 students took on-paper exams only. Comparing the results obtained various exams conducted indicated that there was considerable distraction among first year medical students over the on-screen exams. The scores obtained were graded as "A" for 90-100% marks, "B", "C", "D" and "F" for 80-89%, 70-79%, 60-69% and 0-60% respectively. Hogana (2007) formulae was used to calculate the distraction index (DI) wherein the % of students scoring highest grade was subtracted with the % of students scoring lowest grade. Distraction by the students in a particular exam was assessed by a negative value of DI and vice-versa. A remarkable distraction in the on-screen exams with a DI of -33 between on-paper and on-screen exams was observed. 29% of the students scored "A" grade in the on-paper exam whereas in the on-screen exam only 19% were able to obtain this grade. Analysis of the date about students failing ("F" grade) in the exam revealed that only 3% of students failed in the on-paper exam as compared to 26% in the on-screen exam. More time was taken by the students for completing the exam on-screen which was 46 minutes as compared to on-paper exam, where the average time taken to complete the exam was only 36 minutes. In conclusion we can say that there will definitely be some degree of distraction during the on-screen exams as compared to on-paper exams. More studies are needed to conclude the exact degree of distraction over the on-screen exams with a wide population of universal students.

KEYWORDS

Electronic exams, electronic learning, exam using pen and paper, exams using electronic media, index of distraction, method of assessment.

I. INTRODUCTION

There has been a 'mini-revolution' in the last quarter of a century or so in the university sector. With the 'massification' of higher education, the student profile has changed socially, culturally, and economically [5], and there has been spectacular change in the area of educational technology. Professional journals and conferences dedicated to teaching and learning have produced a steady stream of literature reporting on a wide range of research projects including, experiments with new classroom techniques, modes of flexible delivery, online pedagogies, and the increasing use of multimedia [6]. The end-of-semester examination at the university level has not changed despite this quite momentous transformation that has taken place.

Use of computer based technologies to deliver a wide range of solutions that improve information and presentation [1, 2] is electronic or E-learning. Use of this learning method by medical instructor can improve the efficiency and effectiveness of educational interventions in

the face of the social, scientific, and pedagogical challenges. Use of electronic media either for the study material or for the purpose of exams is highly variable among medical schools and appears to be more common in basic science courses than in clinical clerkships [3, 4].

Research on readability in the past has focused upon the effects of page-layout and typographic variables on reading rate and comprehension, as well as physical and mental human factors. A combination of the reader and typographic variables affect reading rate and reading comprehension, as pointed out by Holmes (1986) by a prior research in the area of functionality of textual information–or readability [9]. Researcher's findings related to the display of information on the new computer display media such as CRTs and LCDs are less conclusive. The rapid evolution of digital typographic tools and display technologies call researchers to periodic appraisal in order to guard against inefficiency, although research exists which scrutinizes the differences between the readability of textual material on-paper and on-screen.

There has been increased research interest upon the use of electronic media in comparison to paper. There are many publications on the 'myth of the paperless office [7], but this does not necessarily prove which medium will dominate, on the extent of their similarity or otherwise. Online exam is increasingly being used at University level [8]. Hence it is essential to know whether onscreen-based tasks are equivalent to paper-based ones and what aspects control the use of these two media.

As per previous research, reading in print is 20-30% faster than reading on a screen, but the divergence is vanishing rapidly as gadgets are advancing. A latest investigation illustrate that reading using a Kindle is just 10.7% slower than on paper and it is only 6.2% slower to read on an iPad. The effectiveness and comfort of reading on a computer screen is obviously different when compared to reading on a tablet or any other reading device. iPad,

Kindle 2, and printed book were nearly tied at 5.8, 5.7, and 5.6 respectively, on a scale of 1-7, while the PC monitor ranked last at 3.6 points. The readers in a research study thought (incorrectly) that they retained more when they read using print. However statistical analysis of the date in this study showed that there was no disadvantage to comprehension between reading in print and reading on tablets and eReaders. Exactly the same results were obtained in yet another study among medical professionals [14].

There persists two disciplines and opinion on the topic of electronic content. The first retain that paper is far better and will never be replaced by screens [10, 11]. The second authority prefer the use of electronic text, due to its ease of storage and retrieval, flexibility of structure and saving of natural resources as major incentives. Electronic text will soon replace paper, according to this perspective, and in a short time we shall all be reading from screens as a matter of habit [12]. Electronic text of the future is unlikely to be handicapped by limitations in the screen image and portability that currently seem major obstacles because the technology is fast developing. Furthermore, paper is an information carrier par excellence and possesses an intimacy of interaction that can never be obtained in a medium that by definition imposes a microchip interface between the reader and the text. It is guaranteed that there will be existence of paper documentation for many years yet; as the millions of books that exist now will not all find their way into electronic form [13].

A student is very apprehensive when faces an exam. Exam solicitousness is extortionate worry about upcoming exams, trepidation of being evaluated, and apprehension about the consequences. Lifestyle issues, information needs, studying styles and psychological factors can be a few reasons that contribute to exam solicitousness. Inadequate rest, poor nutrition, an extravagant quantity of stimulants, insufficient exercise, not scheduling available time and not prioritizing commitments are the some of the lifestyle issues that can

contribute to exam solicitousness. Information needs that can contribute to exam apprehensiveness are academic information such as course requisites, exam-taking strategies, exam dates and testing location, edifiers' prospects, erudition of how to apply apprehensiveness reduction techniques while studying/afore an exam/during an exam. Studying styles that lead to solicitousness can either be ineffective like not making review notes, not reviewing, not studying, reading without understanding, can't recall the material or inefficient like inconsistently erratic content coverage, endeavoring to memorize the textbook, binge studying, distance environment, all-night studying afore exams. The Psychological Factors include feeling no control over the exam situation (rather than kenning and applying exam strategies), negative cerebrating and self-reproval (rather than being one's own best friend), irrational contemplating exams and outcomes, irrational notions "If I don't pass my (parents/partner/boss) will kill me!" Irrational demands "I have to get 100%, or I am worthless." Catastrophic presages "I'll fail no matter what I do." Hence it can be verbalized that already there are so many precincts of exams and integrated to this - will giving onscreen exams integrate yet another factor to exam solicitousness?

Precision of reading could refer to any number of everyday activities such as locating information in a text, recalling the content of certain sections and so forth. In experimental investigations of reading from screens the term precision have several construal too though it most commonly refers to an individual's ability to identify errors in a proofreading exercise. While a number of studies have been carried out which failed to report precision differences between Visual Display Units (VDUs) and paper [15, 16], recent well controlled experiments by Creed et al [17] and Wilkinson and Robinshaw [18] report significantly poorer precision for such proofreading tasks on screens.

So as to overcome and clarify the aforesaid points of view, this paper evaluates the degree of distraction or diversion, if any, especially by first year medical students may experience during an exam as a result of on-screen commotion, in comparison to on-paper harmony.

II. MATERIALS AND METHODS

on-screen and on-paper exams were conducted by the Department of Biochemistry at the College of Medicine, King Khalid University, Abha, Kingdom of Saudi Arabia inorder to evaluate the degree of distraction by the first year undergraduate medical students during online. 123 boys and 57 girls; totaling to 180 participated in these exams. The distribution of these students into various groups was as follows:

(1) **Category I – On-paper exam only:** Just pen and paper exam was taken by thirty one (31) male students.

(2) **Category II – On-screen exam only:** The questions were displayed on-screen (LCD desktop monitors) for another thirty one (31) male students for taking the exam.

(3) **Category III – On-paper exam followed by On-screen exam (Boys):** Initially the exam was conducted using pen and paper wherein sixty one male students (61 boys) participated, which was followed by taking the same exam with the same set of questions displayed on-screen. Neither any time gap given was given between the two exams nor were they allowed to leave the exam hall.

(4) **Category IV– On-paper exam followed by On-screen exam (Girls):** Initially the exam was conducted using pen and paper wherein fifty seven female students (57 girls) participated, which was followed by taking the same exam with the same set of questions displayed on-screen. Neither any time gap given was given between the two exams nor were they allowed to leave the exam hall.

The brilliant, average and poor students were distributed equally into each of the above categories, based upon their performance in a

previous examination. The various types of exams mentioned had the same set of questions.

There were 30 multiple choice questions in the exam, wherein 7 questions were thought provoking tough to solve, direct and easy questions numbered to 15 and rest of the 8 questions were twisted and difficult. The difficulty index of the questions as perceived by the instructor and that analyzed by the software is summarized in the table number 1.

Table 1. Data showing the number of questions with varying difficulty signs in relation to the answers given by all the students

Difficulty sign	Index of Difficulty	Number of questions		Mean
		As perceived by the instructor	As analyzed by the software	
Tough Questions	< 30 %	7	7	7
Direct Questions	> 80 %	16	15	15.5
Twisted Questions	30 % to 80 %	7	8	7.5

Total time of 60 minutes was given at the rate of two minutes to answer these 30. The software programme used to prepare and present the questions on-screen was Questionmark Perception Tool (QMP). The students were able to navigate through all the questions up and down repeatedly and have the chance to change their answer anytime, before submission, as these questions appeared on a single screen. The number of attempts allowed for the on-screen exam was one only, and exam when time expires the system was set to auto-submit the results. In the on-screen exams, there was randomization of questions and options for the answers appearing to each of the student. The exam was well invigilated and further the option of randomization of questions and answers reduced the chance of copying among each other. Two different modules of the hard copy of the question paper were prepared, each module having questions in a different sequence and answers for each in random order. This curtailed the copying during the on-paper exam.

The fraction of marks achieved by each of the student in different categories, in all the above exams were analyzed and compared to evaluate the degree of distortion, or otherwise, in relation to on-paper exam verses on-screen exams. The grading of the marks obtained was as follows: 0 – 59 percent was regarded as "F" (fail) grade; 60 – 69 as "D" grade, 70 – 79 as "C" grade, 88 – 89 % as "B" grade, 90-100 percent marks were graded as "A" grade.

The formula proposed by Hogana [19] was used to calculate the distraction index (DI) as follows:-

% of students scoring highest grade

$$- \qquad (1)$$

% of students scoring lowest grade

A positive value of distraction index indicates that the distraction over on-screen is less as compared to on-paper and a negative value of distraction index specify that the students were more diverted.

To compare the readability and competence of the students to answer the questions on-paper, and on-screen, the mean duration taken by the students to finish the two types of exams was also noted.

Each and every student was interviewed personally after the exam to evaluate and to get their views regarding the pros and cons of on-screen and on-paper exam, and to note their grievances, if any.

Analysis of Data

Blackboard version 6.1.3 available over the e-learning web site of King Khalid University, Abha, Kingdom of Saudi Arabia was used for the analysis of the data.

III. RESULT

Overall it was observed that the students were sufficiently distracted when they took the exam on-screen. The diversion was more profound (-33) when the exam was compared for the students taking the on-paper and on-screen exams separately. However, the two exams were conducted simultaneously with on-paper followed by on-screen exams the attentiveness among boys (-10) and girls (25) differed (Figure 1). The percentage of students scoring different grades in the exam conducted on-paper and on-screen are presented in table No. 2 and figure 2.
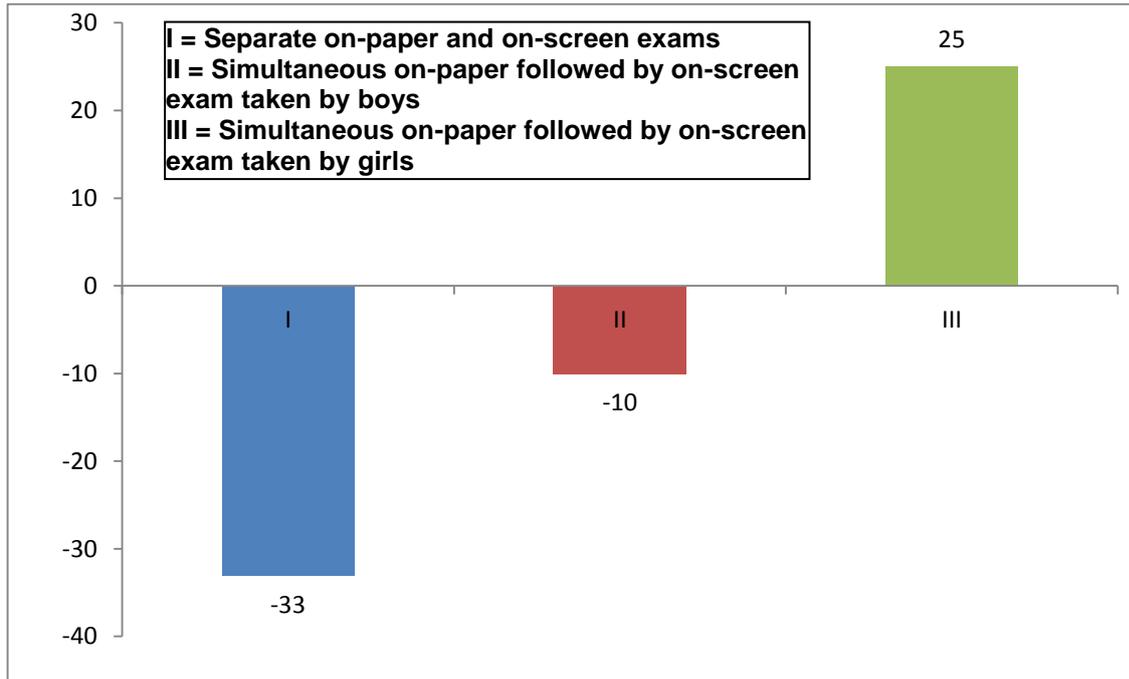

Fig 1. Distraction index (DI) for the three different sets of exams.

Table 2. Distraction Index for the on-paper verses on-screen exams by boys taking the two exams separately

	Category → ↓ Grades	Category I – On-paper exam (N = 31 boys)	Category II – On-screen exam (N = 31 boys)	Percent Distraction (Category II – Category I)
Various grades scored by the students (%)	A	29	19	-10
	B	16	16	0
	C	42	16	-26
	D	10	23	13
	F	3	26	23
	Index of Distraction (DI)	-	-	-33

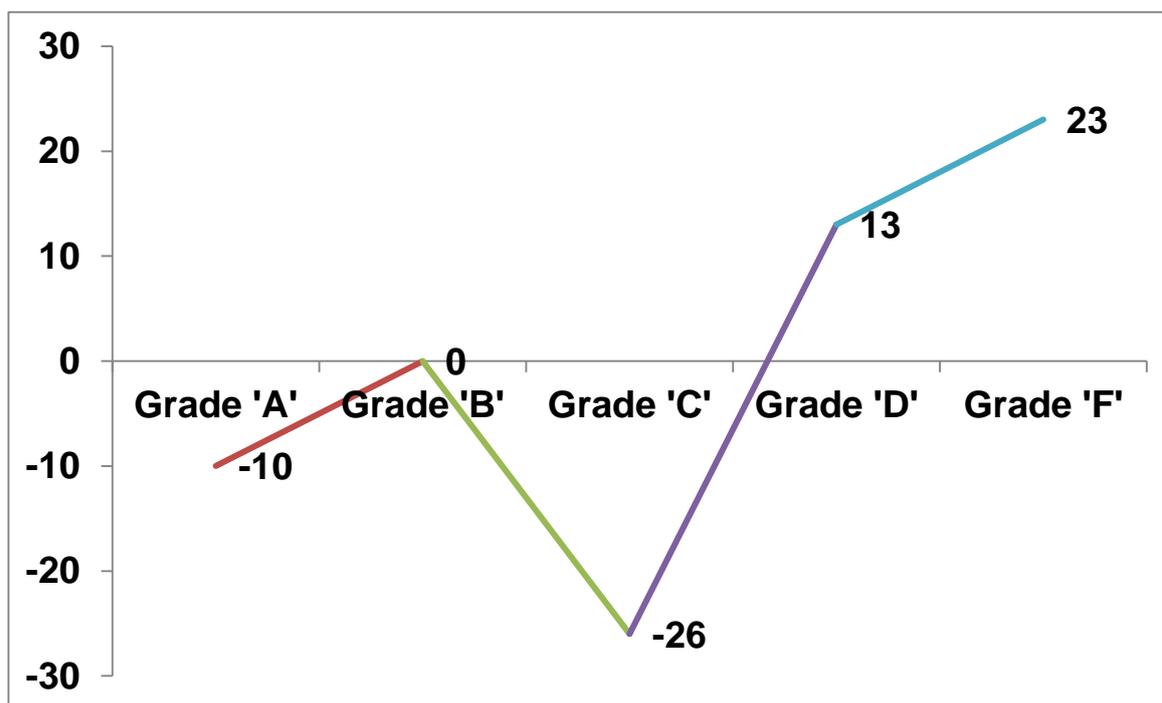*A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; F = 0-60%.*

Fig 2. Distraction Index for the on-paper verses on-screen exams by boys taking the two exams separately

There was a reduction of 10 % in the students scoring "A" grade for the on-screen exams as against on-paper exam as evidenced by the results of the two types of exams. Moreover, there was an increase in the number (23%) of students failing ("F" grade) in on-screen exams in relation of on-paper exam. The percentage of students scoring lower grades increased and those scoring higher grades reduced in the on-screen exams in contrast to on-paper exams. There was no difference in the percentage of students scoring "B" grade (0%) when the results of the two exams were compared. The percentage of students scoring "C" grade reduced by 26%, whereas the percentage of students scoring "D" grade increased to 13% in the on-screen exams verses on-paper exams. There was a very high magnitude of distraction among the students while taking the exams on-screen which was confirmed by the high negative value for the distraction index of -33%.

The distraction index was about -10 for two exams conducted simultaneously one after the other without any break, which is not that high as compared to these two exams being conducted separately. A reduction of 8% of the students scoring "A" grade was observed in the on-screen exams as against on-paper exam. Looking into the number of failures ("F" grade), there were only 2% failures more in the on-screen exams as against on-paper exam. The intermittent grades recorded were an increase of 8% in "B" grade, 1% reduction in "C" grade and no change in "D" grades in the on-screen verses on-paper exam (Table-3,figure-3).

Table 3. Distraction Index for the on-paper verses on-screen exams by category III boys taking the two exams simultaneously

	Category → ↓ Grades	Category I – On-paper exam (N = 31 boys)	Category II – On-screen exam (N = 31 boys)	Percent Distraction (Category II – Category I)
Various grades scored by the students (%)	A	64	56	-8
	B	15	23	8
	C	11	10	-1
	D	5	5	0
	F	5	7	2
	Index of Distraction (DI)	-	-	-10

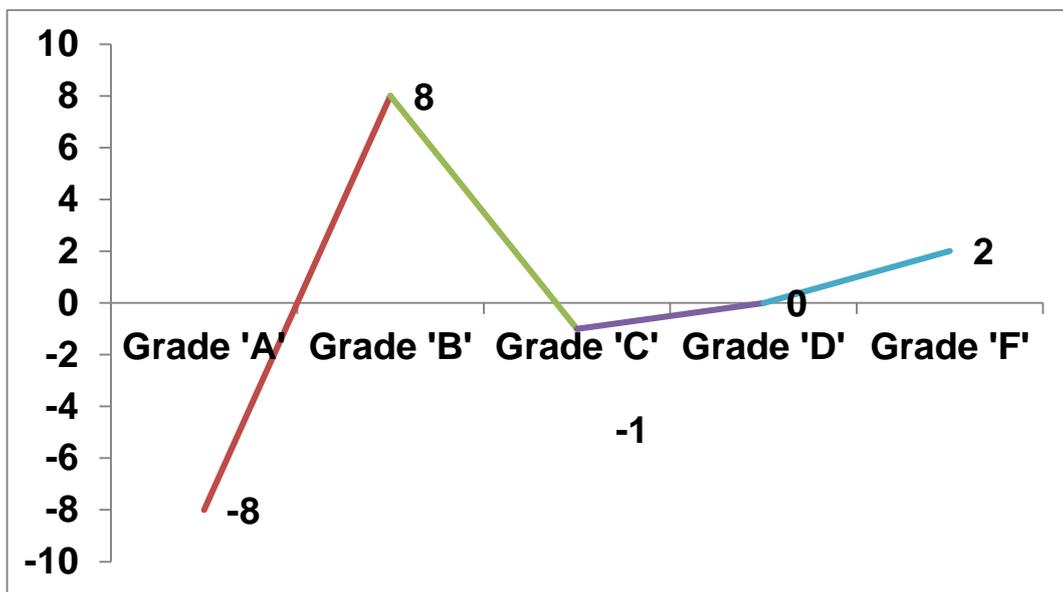*A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; F = 0-60%.*

Fig 3. Percent distraction in the grades scored by the category III male students (N = 61) during the on-paper verses on-screen exams taken simultaneously.

The trend with the female students (category IV) revealed contradictory results as against male students which is depicted in table No. 4 and figure No. 4. When the two exams were conducted simultaneously one after the other without any break with the girls, a high positive distraction index of +25 was obtained. Furthermore, there was an increase in the students scoring "A" grade to 16% in the on-screen exams as against on-paper exam.

Table 4. Calculation of percent distraction during the on-paper verses the on-screen exams by category IV girls taking the two exams simultaneously

	Category → ↓ Grades	Category I – On-paper exam (N = 31 boys)	Category II – On-screen exam (N = 31 boys)	Percent Distraction (Category II – Category I)
Various grades scored by the students (%)	A	26	42	16
	B	18	18	0
	C	21	16	-5
	D	18	16	-2
	F	18	9	-9
	Index of Distraction (DI)	-	-	25

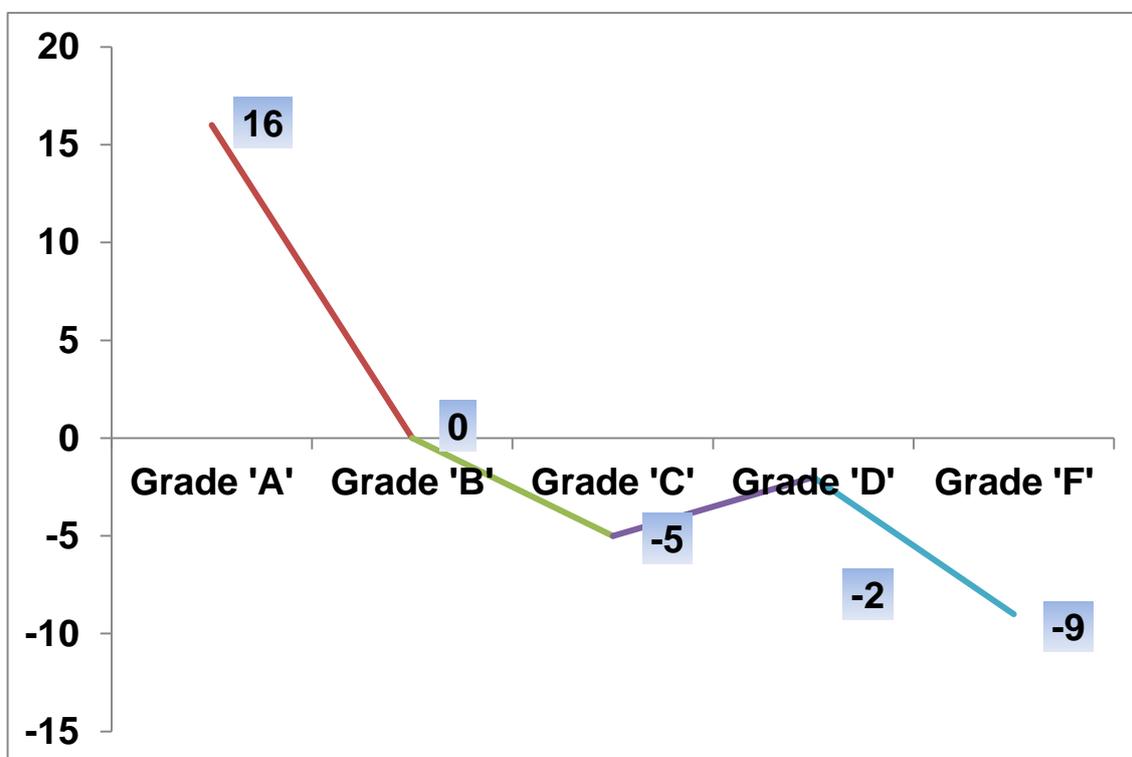*A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; F = 0-60%.*

Fig 4. Distraction (%) in the grades scored by the category IV girls students (N=57) for on-paper verses on-screen exams taken simultaneously

Moreover, there were only 9% failures ("F" grade) in the on-screen exam as against 18 "F" grade students in the on-paper exams. The intermittent grades recorded were no change in "B" grade (0%), 5% reduction in "C" grade and 2% decrease of students scoring "D" grade in the on-screen verses on-paper exam.

The mean time taken in various exams by the students is presented in table No. 5. Students took more time to complete the on-screen exam as compared to on-paper exam. Mean duration to complete the exam by all the students was 38 minutes for on-paper exam against 46 minutes for on-screen exams; indicating that more time was taken for the on-screen exam compared to the on-paper exam. Mean duration to complete on-paper exams was 35 minutes for boys and 33 minutes for girls and the mean time to finish the

followup on-screen exam took 19 minutes for boys and 15 minutes for girls. The reason for the shorter duration taken for the follow-up on-screen exam was that the students were already exposed to the questions and their options in the on-paper exam.

Table 5. Mean duration to complete the various types of exams by different category of students

Sl. No.	Exam module	Mean duration to complete the exam (30 MCQ)
1	On-Screen only (N = 31 boys)	46
2	On-paper only (N = 31 boys)	38
3	On-paper waiting for on-Screen follow-up (N = 61 boys)	35
4	On-paper waiting for on-Screen follow-up (N = 57 girls)	33
5	Follow-up on-screen exam after completing on-paper exam (N = 61 boys)	19
6	Follow-up on-screen exam after completing on-paper exam (N = 57 girls)	15

IV. DISCUSSION

The present study was aimed at evaluating the percent diversion, if any, by the students taking exams on-screen in comparison to pen and paper exam. It has been researched, documented, well debated, and argued upon the utilization of electronic media with reference to readability, comprehension, metrics of speed, precision etc. [20-27]. Further to these reports we wanted to study the on-screen diversion during exams, by first year undergraduate medicos, emanating from a non English naïve background, and schooling.

In our study, we found that there is a great deal of diversion as a result of students taking on-screen exams against on-paper exams. The diversion index of -33 was observed between the two category of students taking exams on-paper and on-screen (Table-4). As per Hogana [19] a negative value of DI is a denotement of diversion. A homogeneous effect was observed in the exam conducted with 61 boys, wherein an on-paper exam was followed by another on-screen exam, and the calculated DI was -10. The low DI (though negative) for category III as compared to category I and II was because the students were pre-exposed to the questions and their options on the paper and on the screen they had just to mark the answers already given over paper. The positive DI in case of girls can be attributed to the vigilance, vigilantness and sharp recollection power of a female mind. Hence girls recalled the answers they had given over paper and thus reproduced them on-screen which resulted in a DI of +25. This was not the case with boys.

The main purport of examining a student at the university level is to quantify how much he/she kens about the subject being examined. It is neither designated to filter the students nor to harass them. Advancement in the edification methodology in the last few decades has driven many philomaths to contrivance more incipient and enhanced methods of examining the students, on-screen being one among them. In-order to examine the caliber of a student it is very much indispensable to have good and standard questions so that an extraordinary astute student can answer all of them impeccably well. A student with a medium aptitude can make through most of it if not all and a poor student can strive arduous to solve at least some of the questions and get through the exam. While preparing the questions it must be kept in mind the type of exam being conducted, an evaluation or a competitive exam [28, 29]. In our study, this has been followed as shown in table No. 5.

An examination, for sure, engenders solicitousness among students naturally. Factors

like tardy night studies leads to sleepless nights, inopportune nutrition causes impuissance that integrates to the exam apprehensiveness. Under such circumstances, the students need more facile questions, cool media to look upon the questions and answer them without tension. Questions on a paper will compose the best option to surmount these constraints. Utilize of electronic media for the purport of examination, especially, evaluation type of exams, may cause sundry drawbacks, for instance an incompletely slumbered subject cannot persistently optically canvass a screen for a longer time due to eruption of burning sensation in the ocular perceivers. An infelicitously fed human cannot concentrate impeccably on media with cathode ray tube monitors (flicker, high contrast and fluctuating luminance) hence there should be some distinguishment between the performance on-screen and that obtained from a commensurable paper presentation. Furthermore, presence of the CPU near the student engenders an electromagnetic field which may further lead to physical fatigue of an already tired human subject.

The overall results obtained betokens that with this class of students studied, on-paper exams are more congruous than on-screen exams. There was a reduction in the students scoring "A" grade and increment in the students scoring "F" grades, however there was an exemption in the case of girls taking on-screen exams following an on-paper exam. Furthermore, there is a fair distribution of the students among the sundry grades in the on-paper exam under review in this article. A good result should, nevertheless exhibit a bell shaped curve. Among our results, the on-paper exam for category-I students showed a curve near bell shape, which is an example of excellent system of examination. The average time taken to consummate the on-screen exam was withal more when compared to on-paper exam.

University examinations perpetuate to be dominated by pen and paper tests. It is argued here that this is something of an anachronism given the human capital desiderata of a cognizance economy, not just because of the absence of technology that is utilized routinely in everyday business and commerce, but because this type of examination instrument is incompatible with constructivist learning theory that favours deep learning [30]. It is further argued that a commitment to authentic assessment will pave the way for a variant of final examination, where authentic-world quandaries are sanctioned to take centre-stage, and multi-media can be harnessed to provide the learner with a more engaging experience. With more preponderant engagement, this, in turn, can yield more preponderant results in terms of the depth of student learning. Factors which are considered most paramount in favour of on-screen exams are flexibility regarding the location of the exam; a format germane to business/professional inculcation, suited to student's learning style, quality of learning outcomes, and perspicaciously challenging [31].

Overlooking our data, the advantages of online assessment cannot be ignored which includes the richness of the interface (utilization of graphics), prodigious and diverse utilizer population, standardization of the test environment (sundry campuses can have the same exam), the subjective element annexed to handwritten replications is abstracted, online scoring can be expeditious and precise needing very little manpower.

V. CONCLUSION

Though our study depicted that the pen and paper exams are superior than the on-screen exams, with respect to distraction, we do not recommend that pen and paper exams should continue, instead we still propose the use of on-screen exams at the university level in the light of our discussion part.

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